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No. IX.

*An Attempt to ascertain the Fusing Temperature of Metals.
By Joseph Cloud.—Read May 20th, 1814.*

THE fusing or melting temperature of the different metals has long excited the attention of philosophers, and many unsuccessful attempts had been made to ascertain that point, when, at length, the ingenious Mr. Wedgewood invented a pyrometer, which appeared to be sufficiently accurate to indicate the comparative fusibility of such metals as came within its range. To this instrument, however, there are several objections. 1st. As to the accuracy of its *zero* stated to be equal to $1077\frac{1}{2}^{\circ}$ of Fahrenheit, and that each degree of the former is equal to 130° of the latter. 2d. Mr. Wedgewood found, from experience, that the pyrometrical pieces were liable to suffer variable contractions, at the same temperature, from circumstances in their preparation, apparently minute. And another source of error, not easily avoided, is, that natural clays, taken from the same bed or stratum, and apparently of similar qualities, differ considerably in the contractions they suffer. 3d. Experiments with the pyrometer pieces seem to lead to the inference, that their contraction is, in some degree, proportioned to the quantity or duration, and not simply to the intensity of the heat applied. Having noticed the present state of our knowledge on this branch of science, I shall endeavour to point out a method for ascer-

taining the fusing temperatures of the metals in a way less liable to error.

The dilatation observable in the fusion of metals is a proof that the particles are separated, and kept at a distance from each other, by the interposition of caloric between their integrants, sufficient to overcome their attraction of cohesion, and their *vis inertiae*. And when certain degrees of temperature are excited, they lose their solidity and become fluid. From these general laws of fusion, it necessarily follows, that the melting heat of a metal will be governed both by its attraction of cohesion, and *vis inertiae*; and that the comparative fusibility of the metals will be in the compound ratio of their comparative attraction of cohesion, and specific gravity.* In order to illustrate this position, I have availed myself of Mr. Guyton Marveau's experiments on the attraction of cohesion of the metals, by which he found that wires of 0.787 of a line in diameter required the following forces to tear them asunder. Iron, 549,250lbs. copper, 302.278lbs. platinum, 274.320 lbs. silver, 187.137lbs. gold, 150.753lbs. zinc, 109,540lbs. tin, 34.630lbs. lead, 27.621lbs. I shall also make use of the specific gravities as stated by chemical authors.—Iron, 7.788, copper, 8.667; platinum, 23.543; silver, 10.510; gold, 19.361; zinc, 6.861; tin, 7.299; lead, 11.352. Now, as it has been ascertained that, in the fusion of tin, 442° of Fahrenheit's scale are required to overcome the combined powers of 34.630 attraction of cohesion, and 7.299 of *vis inertiae* (spec. grav.) I have taken them as a standard to find the melting temperature of the other metals, by the following proportions. If 34.630 multiplied by 7.299 require 442°, what will 150.735 multiplied by 19.361 (the attraction of cohesion and specific gravity of gold) require? The answer will be 5103° degrees of Fahrenheit, the fusing point of gold.

* As the tendency in bodies to be at rest, and consequently the force required to put them into motion, depends upon their weight, their specific gravity furnishes us with an easy and correct method of ascertaining their comparative *vis inertiae*.

By proceeding, as in the above example, with the other metals, we shall obtain the following results as their fusing temperature—platinum, 11293° —iron, 7480° —copper, 4581° —silver, 3439° —zinc, 1314° —lead, $548^{\circ}.3$. This last turns out to be the precise temperature at which Sir Isaac Newton found lead to melt.—If the above results are reduced to Wedgewood's scale, they will be found to differ but little from the fusibility given by chemists, of such metals as come within the lower range of that scale. The only two in which there is much difference are platinum and iron, this may probably arise from the circumstance of the contraction of Wedgewood's pyrometer pieces being governed by the quantity and not merely by the intensity of the heat applied; these refractory metals necessarily requiring a longer continuation of it, before a sufficient degree can be excited to effect their fusion.—Chemical writers state platinum to melt at 170° of Wedgewood, equal to $23177\frac{1}{2}^{\circ}$ of Fahrenheit; and iron at 158° of Wedgewood, equal to $21617\frac{1}{2}^{\circ}$ degrees of Fahrenheit; from which it would appear, that the difference in their fusibility is but 1560° of Fahrenheit. This trifling disparity can hardly be accounted for, when we consider that the fusion of iron is completely within the range of a common melting furnace, and that platinum can only be fused, even in small quantities, by means of a powerful lens, a combination of oxygen and hydrogen gases, or by combustion urged by a stream of pure oxygen gas.—Again, gold is stated to fuse at 32° of Wedgewood, equal to $5237\frac{1}{2}^{\circ}$ of Fahrenheit, which is 16380° of Fahrenheit below the fusing temperature of iron; now, here is a difference that cannot be correct; and the most common observer, at all acquainted with the fusion of metals, must be convinced of the error.—Palladium is stated to fuse at 160° of Wedgewood, equal to $21877\frac{1}{2}^{\circ}$ of Fahrenheit; which is 260° of Fahrenheit above the fusing point of iron; to this error I can testify, from frequently fusing that metal in a common air-furnace; but as I have not had an opportunity of ascertaining its attraction of cohesion, I am unable to calculate its precise fusing temperature; which, however, appears to be greater than that of gold, but far less than that of iron.